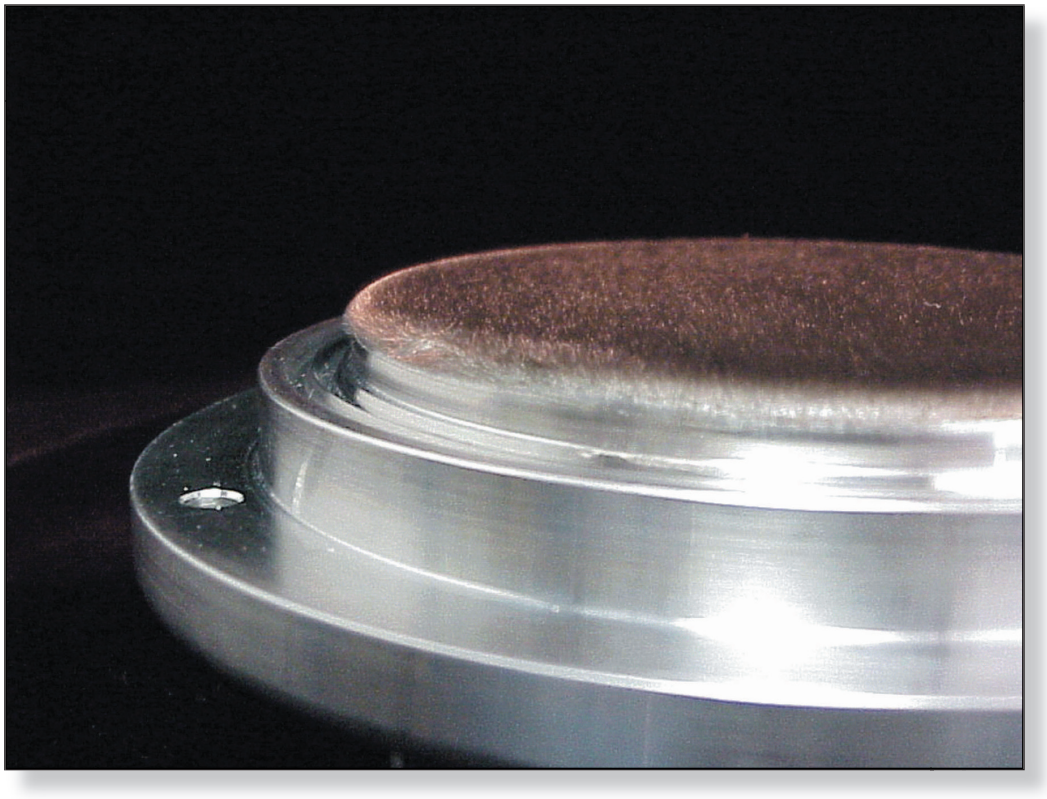
Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Success Story

CESIUM IODIDE CARBON FIBER CATHODE PROVIDES FOR A VARIETY OF APPLICATIONS



The Directed Energy Directorate's cesium iodide carbon fiber cathode serves as a versatile, low-work function, field emission cathode for a variety of applications, ranging from conventional and high-power microwave (HPM) tubes to X-ray tubes and flat-panel displays. The cathodes constitute a breakthrough in electron emitter technology, allowing efficient current emission with low out-gassing and long cathode lifetime.

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Accomplishment

The directorate integrated the cathode into an existing HPM device, yielding impressive results and exceeding all previous capabilities of the HPM device under test. The cathode emits and shows no sign of impedance collapse, significant for long radio-frequency (RF) pulse-length operation. The cathode also does not appear to increase the out-gassing of the system, important to repetition-rate capability and for the weight reduction of the overall system. The cathode emits at much lower voltages than any cathode previously used in the HPM device, allowing the HPM device to be used with a wider range of voltage and power operation. The HPM device can now operate at a lower power threshold, without having to throw away unused power. This leads to a plethora of convenient operation options with the new cathode.

At every voltage/current/pulse-length setting tested, the resulting RF pulse tracked the voltage pulse in terms of rise time, pulse length, and fall time, a first for any cathode in the HPM device. This resulted in a significant increase in the overall energy efficiency of the device. The cesium iodide carbon fiber cathode operated at repetition rates up to 60 Hz with a total of greater than 10,000 shots with no sign of performance or physical degradation. This greatly increases concept of operations options available to the warfighter.

Background

HPM devices require robust, long-lifetime, lightweight, high-current cathodes with low levels of neutral gas production. Traditional cathodes suffered either from short lifetimes and large amounts of neutral gas production in the case of field emitters, or from low efficiency and large weights in the case of thermionic emitters. Hence, the directorate required a significant improvement in cathode technology to make HPM devices feasible.

In 2001, the directorate completed testing of a prototype cathode in an idealized test geometry, demonstrating a lifetime of more than 1 million pulses. To prove operational feasibility in a real device, the directorate initially deployed the cathode in a single-shot HPM tube, with great success. However, repetition-rate operation for long lifetimes remained unknown.

Directed Energy
Technology Transfer

Additional Information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (04-DE-05)